# Mobile Marking Cart

## Monode Marking Products, Inc.

### St. Louis, MO

### 9 Dec 2003

RVSI READY.

Monode™

# Monode Marking Products, Inc.

- 50+ years in business
- Original Equipment Manufacturer
- Distributor
- Integrator
- Metal Stamp, Dot Peen, Electro-chem Etch, Laser

RVSI READY.

Monode™

## Desert Storm

A General Accounting Office (GAO) study estimated the DoD could have saved $2 billion in Desert Storm inventory, from a $2.7 billion total inventory through better information about available inventory.

- Automatic I.D. News, Sep99, Vol. 15 Issue 10, p36, (The GAO report was issued in September 1992)

RVSI READY.

Monode™

# Directive Actions- Dept of Defense

- Under Secretary of Defense AT&L - Unique Identification (UID) mandatory on all new solicitations.
  - Advance Policy Issued Dec 02
  - First IPT Meeting held on 12 Feb 03
  - Additional Meetings Mar, Apr, May, June, July
  - Policy Issued 29Jul03

# UID Milestones

- UID Required for all solicitations starting 1/1/04
- UID Required for GFE starting 1/1/05
- CAE's/PM's encouraged to begin implementing NOW

# UID Applicability

- Components or parts valued over $5,000.00
- Serialized
- Controlled Item
- Mission Essential
- Pilferable

# Integrated Approach

- Incorporates and applies to financial, acquisition, and logistics systems.
- UID will be informational CLIN on contracts.

# The Current System

Field use or repair operations is a problem area due to the “paper trail”

Parts + Assemblies

Stacks of Paper

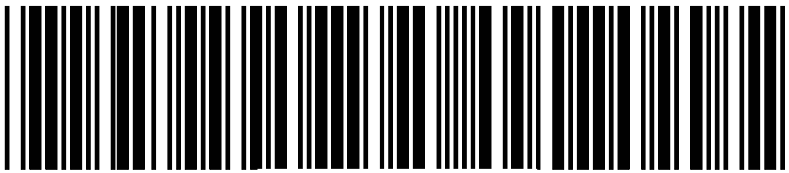
Manual Data Entry

- time-consuming
- error prone
- data not current

The Database

# 2-D Data Matrix vs. 1-D Bar Code

## Bar Codes *1-D One Dimensional*



A1B2C3D4E5

This bar code contains only
10 characters

- Encodes information in one dimension only
- Requires high-contrast; usually 80% & up
- Cannot be made bigger or smaller
- Used for packaging + non-permanent labels

## The Data Matrix *2-D Two Dimensional*

A 52 mm Data Matrix
(approx. 3/10th of an inch)
can contain 400 characters
of information

- Both height & width are used
- Works with contrast as low as 20%
- Readable within 360 degrees
- Holds more data within smaller space
- Can be read when up to 20% damaged

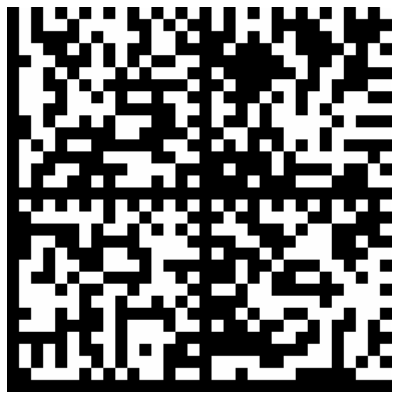
RVSI READY.

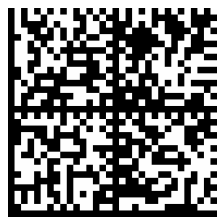
Monode™

# What is a Data Matrix Symbol?

- Machine-readable symbol capable of storing large amounts of information within a small physical area

- Data Matrix is the standard for direct part marking





RVSI READY.

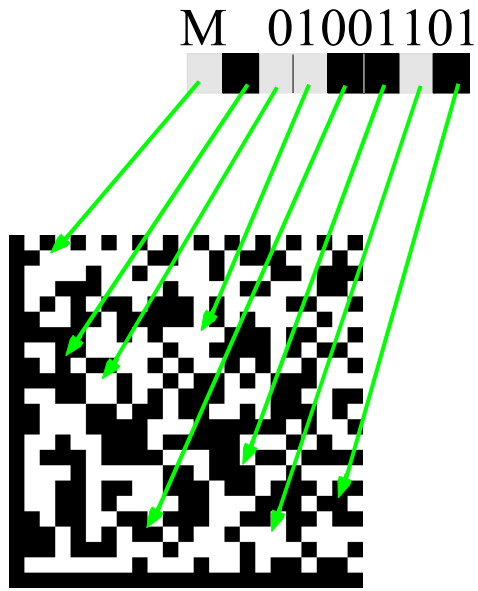
Monode™

# Data Matrix Symbology

- Two-dimensional array of square or round cells in contiguous rows and columns

- Binary code - dark data cells are given a value of “1” and the light cells a value of “0”

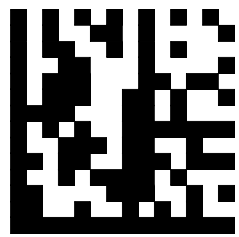
- Each human readable character encoded into the symbol is typically assigned eight data cells



# Advantages of Data Matrix Symbol

- Marking methods that can perform in the harshest environment
- Lose up to 20% of the symbol and recover 100% of encoded data
- Size is only limited by fidelity of marker
- Symbol can hold an order of magnitude more than a linear bar code
- Decode Data Matrix symbol invisible to human eye
- Not language dependent
- Only needs minimum of 20% contrast to decode



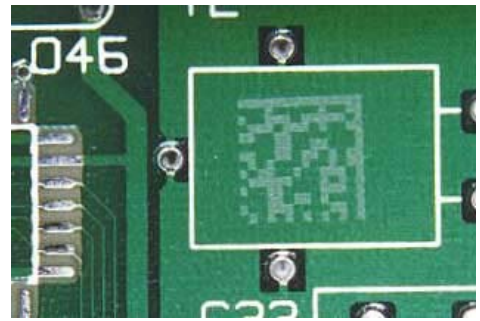
RVSI READY.

Monode™

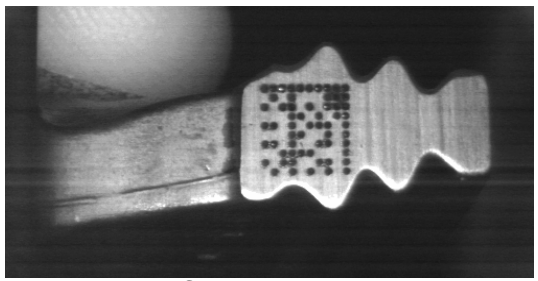
# Existing Data Matrix Applications


Semiconductor – Wafer


Government – Postage

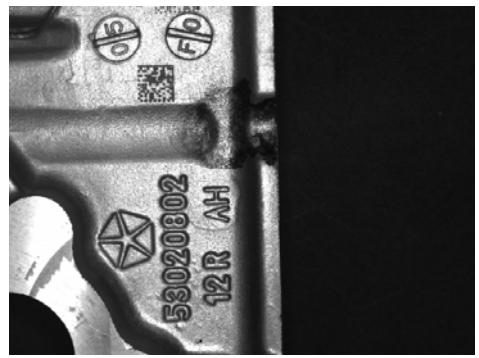



Electronics – PCB



Aircraft – Turbine Blade

Pharmaceutical – Vials




Automotive – Engine Component

RVSI READY.

Monode™

# Data Matrix is the Standard for Direct Part Marking (DPM)

- RVSI has placed Data Matrix in public domain

- Approved as an American and International Standard by ANSI/AIM BC11-1997

**AIAG** Automotive Industry Action Group B-4 Part Identification

**SEMI** Semiconductor Equipment and Materials International
- T2-0298E Marking silicon wafers
- T3-0302 Marking Wafer box labels
- T7-0302 Marking back surfaces of double-sided polished wafers
- T8-0698E Marking glass flat panel display substrates
- T9-0200E Marking lead-frame strips
- T10-0701 Test method for the assessment of direct mark quality

**ATA** Air Transport Association Spec2000 Ch. 9 Data Matrix symbology commercial aviation standard

**EIA** Electronics Industry Association
- 476-B Source and date code marking
- 706 Electronic component marking
- SP 3497 Labeling and identification of electronic products

**AIM** Automatic Identification Manufacturers Association BC 11 Uniform Symbology Specification for Data Matrix

**ANSI** American National Standards Institute AIM USS AIM Uniform Symbology Specification accepted by ANSI

**ISO** International Organization for Standardization 16022:2000 Adoption of Data Matrix symbology

**KSA** Korean Standards Association X 6721 Automatic identification and data capture

**SAE** Society of Automotive Engineers AS9132 Quality requirements for parts marking

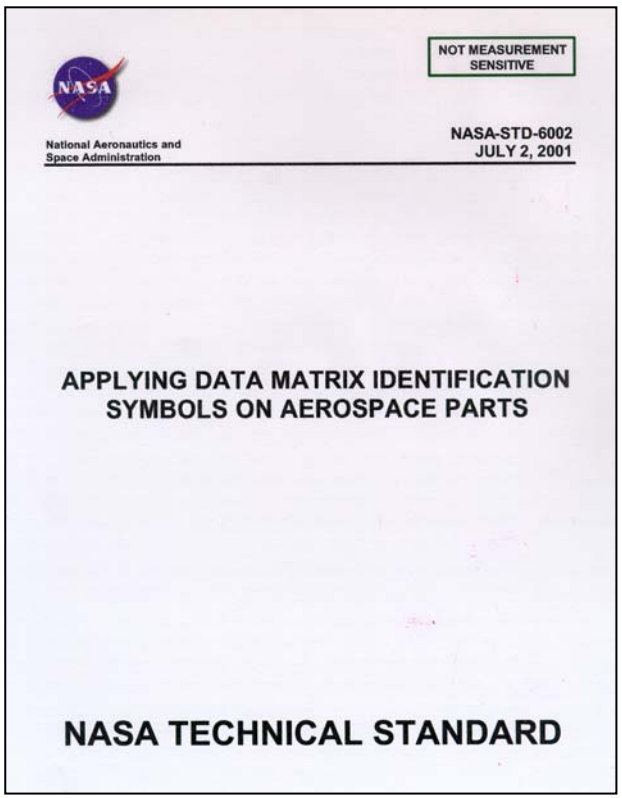
**HIBCC** Health Industry Business & Communications Council – pending

**ISO** International Organization for Standardization 15415 (verification) - pending

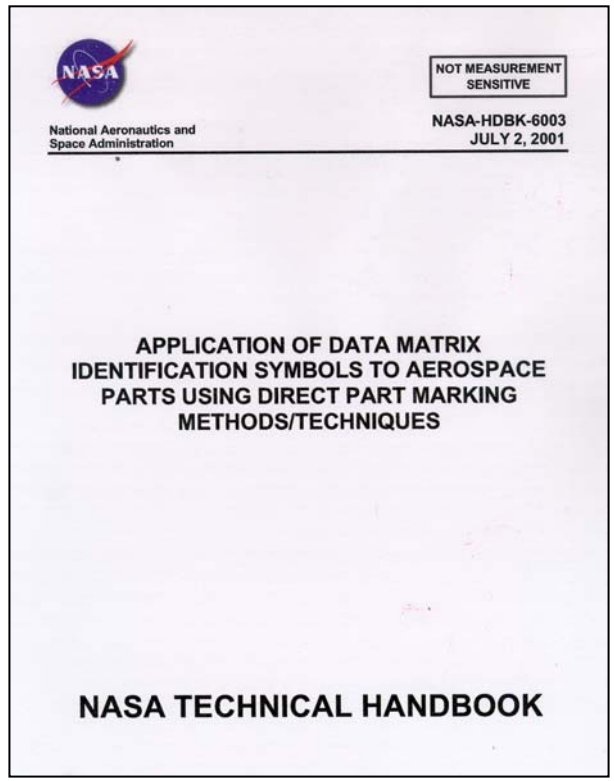
RVSI READY.

Monode™

# NASA Data Matrix DPM Standard and Handbook



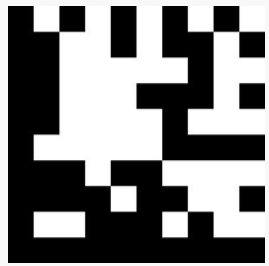

**International standards are being created from these two documents.**



# Direct Part Marking (DPM)

Direct part marking is the technology of applying "machine-readable" marks directly to part surfaces to automate the information retrieval process to:

- Unique part identification (permanent)
- Reduce errors
- Improve quality
- Reduce life-cycle cost and improve readiness



**Direct Part Marks:**

- Identify items during handling, storage, installation, functional use, maintenance, repair, and replacement
- Relate items to documentation and databases that authorize procurement, manufacturer, shipment, storage and installation

RVSI READY.

Monode™

# DPM Requirements

- Remain readable throughout product life
- Withstand all environmental conditions that the product will be exposed to under normal operation
- Provide no detrimental effects on the functionality, reliability, or durability of the product

# Direct Part Marking Benefits-

## Right Part at the Right Place at the Right Time

- Reduce program costs
- Eliminate data transposition errors
- Improve data accuracy
- Provide means to verify part configuration and status prior to installation, repair, and overhaul
- Real-time computer system update
- Reduce inventory
- Track the history and quality of parts

RVSI READY.

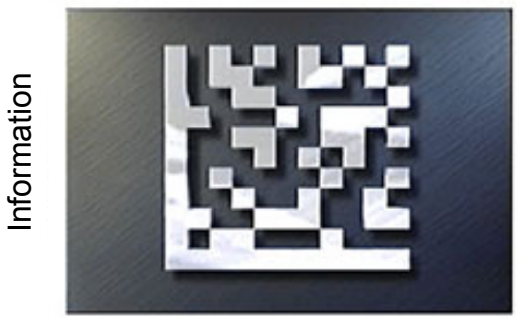
Monode™

# Reasons Why DoD is Implementing UID

- Improves Force Readiness
- Enables serial number tracking of assets
- Supports configuration management
- Deters unauthorized parts usage
- Reduces life-cycle costs
- Reduces man hours
- Reduces human error
- Improves resource utilization
- Increases process control

**Save billions of dollars!**

**Data Matrix represents the next generation of barcode technology**

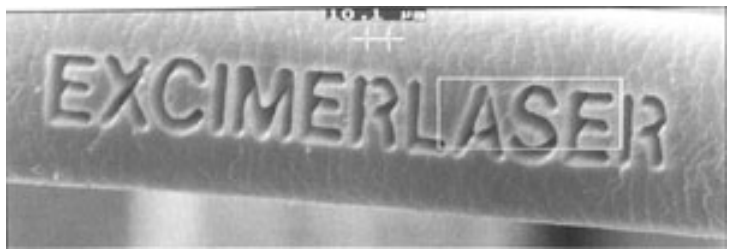



RVSI READY.

Monode™

# Scaleability of Data Matrix Symbology

Data Matrix symbol on the head of a straight pin




Words cut into a human hair using an Excimer Laser

RVSI READY.

Monode™

# Flexibility of Data Matrix Symbology

These marks are readable Data Matrix symbols marked on a feather without damaging the feather.

RVSI READY.

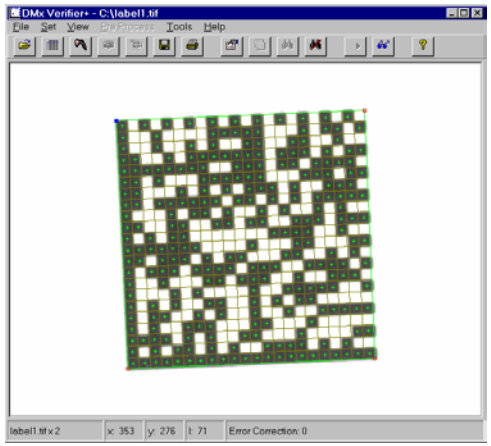
Monode™

# MVRC - RVSI's Traceability Approach

**MARK**


Symbology Research Center - SRC

**VERIFY**




Monode & RVSI Verification Products

**READ**

RVSI Reading Products

**COMPUTE & COMMUNICATE**

Triad

---

Palm Pilot®
(mobile)

RVSI READY.

Monode™

MVRC

# The Four Major Marking Methods

Laser Marking

Ink Jet Marking

Dot Peen Marking

Electro-Chem Etch Marking

RVSI READY.

Monode™

# Two General Types of Marking

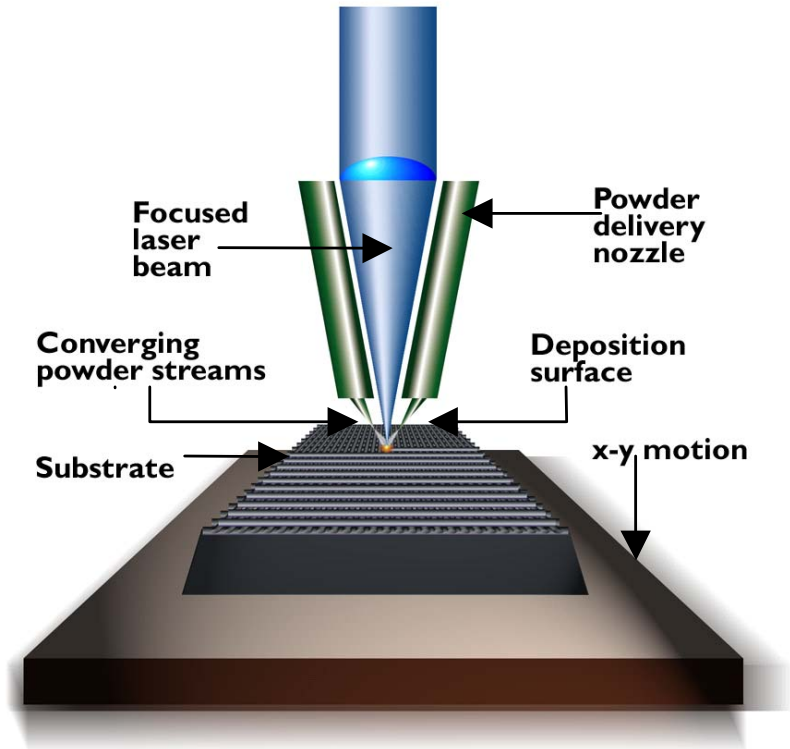
- Nonintrusive
- Intrusive

# Nonintrusive Marking Methods

- **Automated Adhesive Dispensing**
  - **Any fluid application**
  - **Contoured beads, dot dispensing, gasketing, potting, 1 or 2 part materials**
- **Cast**
- **Forge**
- **Mold**
- **Ink Jet**
- **LASER bonding – YAG, $YVO_4$, $CO_2$**
  - **Use $CO_2$ for low heat applications**

# Nonintrusive Methods (cont)

- LENS (Laser-engineering net-shaping)



MVRC

# Nonintrusive Marking Methods

- Liquid Metal Jet (Similar to Ink Jet, extremely small droplets)
- Silk screen
- Stencil
  - Abrasive Blast
  - Acid Etch
  - Chemical Coloring
  - Dip, Barrier, and Chemical Conversion Coatings
  - Plating and Electro-Plating
  - Ink
  - Vacuum and Controlled Atmosphere Coatings and Surface Modification Processes

RVSI READY.

Monode™

MVRC

# Intrusive Marking Methods

- Abrasive Blast
- Dot Peen (with or without backfill)
- Electro-chemical Etching
- Electro-chemical Coloring
- Engraving/Milling
- Micro Milling
- Fabric Embroidery/Weaving

RVSI READY.

Monode™

# Intrusive Marking Methods (cont)

- LASER
  - Short wave length (cooler – excimer)
  - Visible wave length (marking metal)
  - Long wave length ($CO_2$ – wood, leather, some plastics)
- Laser Coloring
- Laser Etching
- Laser Engraving
- Deep Laser Engraving
- Laser Shotpeening

# Intrusive Marking Methods (cont)

- Laser Inducted Surface Improvement (similar to Laser bonding, but with material additive for high corrosion/wear applications)
- Gas Assisted Laser Etch (produce contrast using gas reactant)
- Laser Induced Vapor Deposition (apply marks to transparent material)

MVRC

# Mobile Marking Cart

## "Take the Marker to the Part"

- YAG Laser (mounted or hand held)
- Micro Milling
- Ink Jet
- Electro-chemical
- Stencil
- Dot Peen (column mount and hand held)

RVSI READY.

Monode™

MVRC

# Monode Mobile Marking Cart


RVSI READY.

Monode™

# Verification

- Quality of Data Matrix can be scored
- Same engineering rigor as making the part
- Quality at time of marking is the best it gets – readability
- Closed loop process
- System required to check quality

# Lesson Learned

- Verify and use verification tools

RVSI READY.

Monode™

# Lesson Learned

- **Reading ≠ Verification**

RVSI READY.

Monode™

MVRC

# Verification

- Monode Verification/Triad
- RVSI's DMx Verifier engine
- Conforms to ISO 16022
- Conforms to AS/SJA/PrEN9132
- Custom metrics for DPM
- Easy to use graphics
- Operator Feedback

RVSI READY.

Monode™

MVRC

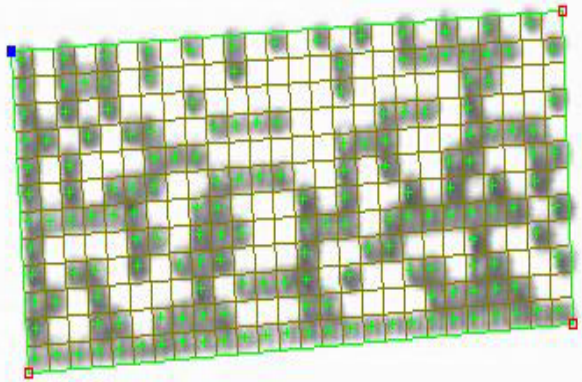
# Verification

## DMx Verifier+ & DMx AutoID+

- Quantitatively measures 2-D marks
- Attributes go beyond AIM industry standard
- Key attributes measured:
  - size and center offset
  - Axial uniformity
  - Print growth
  - Error correction
- Graphical feedback to assess mark quality
- Offline (sampling) or inline (process control)

| | | |
|---|---|---|
| Nominal Cell Size | - | 6 |
| Center Offset | - | 5.023 [15..30%] = 5 |
| Size Offset | - | 1.878 [15..30%] = 1 |
| Correlation Score | - | 0.76 |
| % Border Match | - | 100 |
| % Contrast | C | 52 |
| Axial Uniformity | A | 0 |
| Print Growth | A | X = -0.06 (x 3.3) , Y = 0 |
| Error Correction | A | 0 (UEC: 1.00) |
| Overall Grade | C | (Pass - AIM) |

1T1231234567+3VABCD123



RVSI READY

Monode™

# RVSI Readers

RVSI readers meet the needs of numerous applications

- Read different types of codes
- Read at varying distances
- Read low-contrast marks
- Read damaged symbols
- Read different marking techniques



RVSI READY.

Monode™

MVRC

# Compute - TRIAD

- Middleware – like Windows for Marking
- Controls ALL of the marking and reading systems with a single operator interface
- Connects marking to corporate data systems through Data Binding
- Manage Serialization
- Networkable
- Size for the application

RVSI READY.

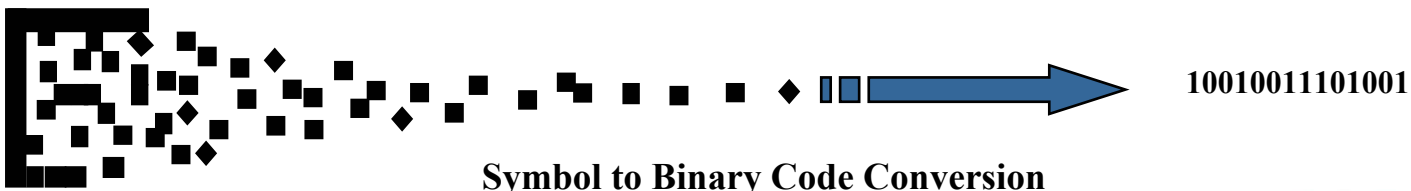
Monode™

# Data Matrix Communications

All of RVSI's Data Matrix products are designed to provide output in universally recognized ASCII data formats and can be transmitted using commonly utilized methods

Transfer Mechanisms

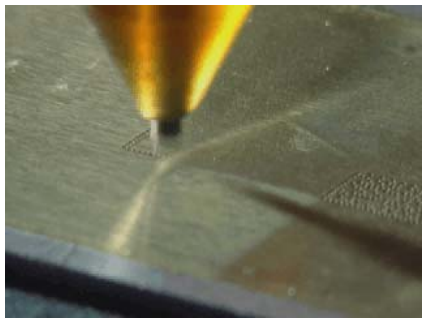
- Floppy Disk
- Hardline
- Telephone (Modem)
- Radio Frequency (RF)
- Infrared (Direct line-of sight)




Symbol to Binary Code Conversion

MVRC

# Communication



Dot peen mark being made on part
RVSI verifier measures quality of mark

RVSI reader decodes symbol

Information sent to host computer

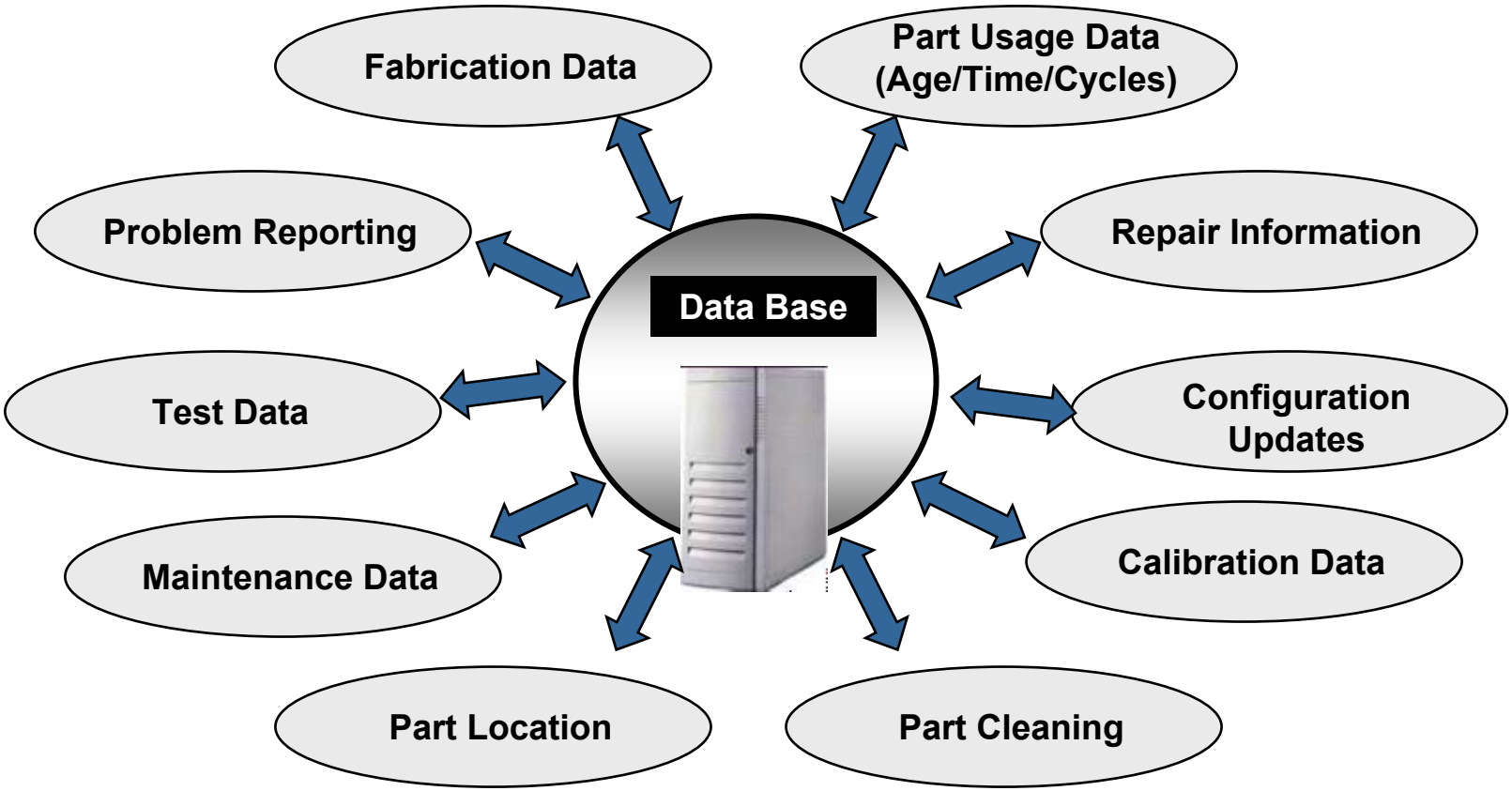
Information sent to world

RVSI READY.

Monode™

MVRC

# Data Matrix Electronically Links Parts To Their History




RVSI READY.

Monode™

MVRC

# Traceability & the Supply Chain

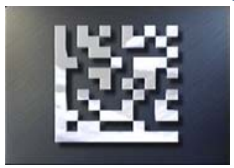
Parts data

Assembly data

Histories and locations of “high-value” parts can be pinpointed

Product data

Service life data



Data Matrix symbol provides the link

RVSI READY.

Monode™

# Government DPM Development Programs

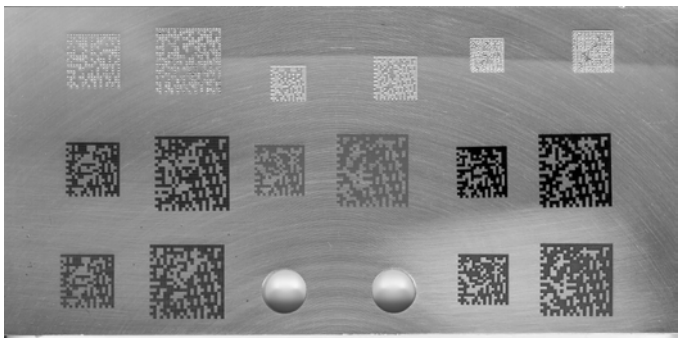
| | |
|---|---|
| 1 How-to-Instructions | NASA Data Matrix DPM Standard and Handbook - Released September 6, 2001 |
| 2 Overhaul Test | USAF Aging Landing Gear Life Extension Program - Underway at Hill AFB, Utah |
| 3 LEO Tests | NASA In-Orbit Test Program – Experiment Launched to International Space Station August 10, 2001 |
| 4 Manned Flight Test | USCG Phase II – Aircraft Flight Critical Part Direct Part Marking Verification Program – In Planning Stage |
| 5 Field Site Marking | DoD Retrograde Parts Marking Program Announcement |

RVSI READY.

Monode™

# USAF Aging Landing Gear Life Extension Program

Eight different marking types being subjected to typical aircraft part overhaul processes



# USCG Phase II – Aircraft Flight Critical Part Direct Parts Marking Verification Program

**500 safety critical parts being flown.**

# Elizabeth City Marking C130's Apr03


# Elizabeth City Marking C130's Apr03

RVSI READY.

Monode™

Commercial Technologies for Maintenance Activities

NCMS An NCMS/DoD Partnership

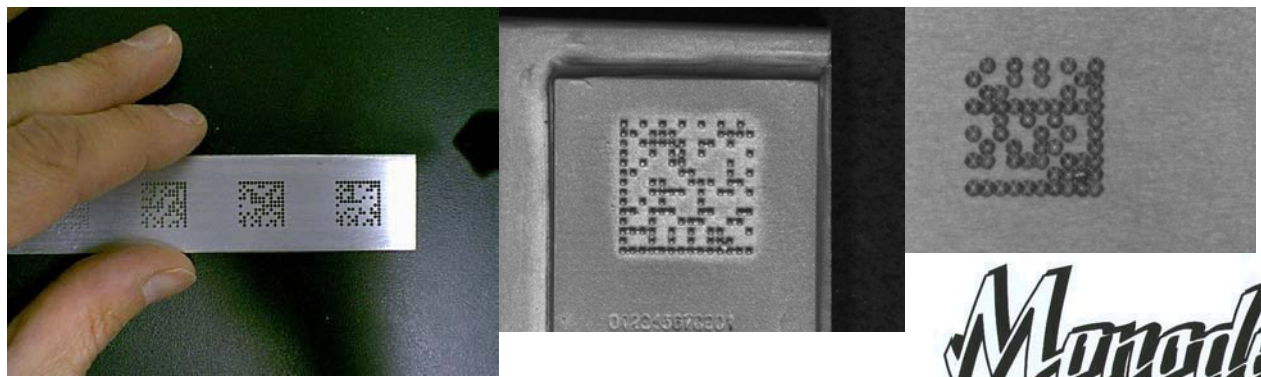
# NCMS Retrofit Marking Program

## Approved by Pentagon May 31, 2002

## The Goals

Use of Data Matrix technology in government applications with emphasis on:

- The use of direct part markings used in (DPM) in harsh operational and overhaul environments
- The marking of parts and components in the field



RVSI READY.

Monode™

# Monode's Mobile Marking Cart (Deliverable, 1 of 3 Versions)

# Monode's Mobile Marking Cart (NCMS Deliverable, 1 of 3 Versions)

# Government Interest

Test results shared with:

- Congress (The House Aviation Subcommittee)
- Department of Transportation
- Defense Logistics Agency
- Federal Aviation Administration
- National Aeronautics & Space Administration
- National Transportation Safety Board
- United States Air Force
- United States Army
- United Stated Coast Guard
- United States Navy

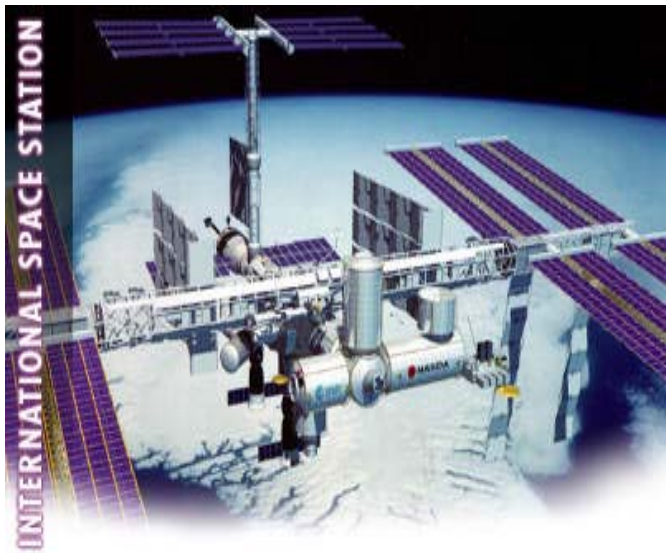
RVSI READY.

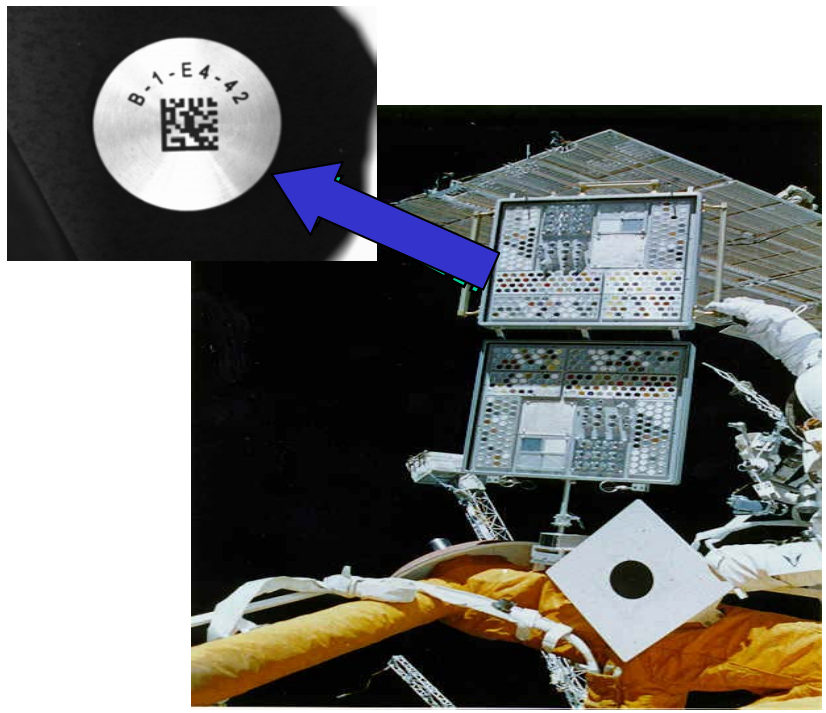
Monode™

# NASA/ RVSI Experiment M-ISS-E

Direct Part Marks are on the outside of the International Space Station

Twelve different marking types being subjected to low earth orbit environments




Markings will be certified for use in reusable spacecraft

RVSI READY.

Monode™

# Implementing UID – Lessons Learned

- Education/training/2D knowledge base
- No one is from Missouri – NOT technology demos
- Marking requirement is unique for each company
- Develop a Business Case
- Develop Implementation Plan
  - Upgrades to legacy systems
  - Integration
  - Migration/cutover
  - Training

RVSI READY.

Monode™

# Implementing UID – Lessons Learned

- Procedural changes
- Migrate UID to:
  - Suppliers
  - Service Centers
  - Field users
  - Clients
- Work with companies who have a track record in direct part marking and reading.

# QUESTIONS

RVSI READY.

Monode™

# Contact Information

**Bob Crazythunder**

**Vice President Govt Markets**

**Monode Marking Products, Inc.**

**crazybob @ mindspring.com**

**703-946-6987 cell**

**425-920-8252 fax**

**THANK YOU**